



Designation: D6943 – 03

## Standard Practice for Immersion Testing of Industrial Protective Coatings<sup>1</sup>

This standard is issued under the fixed designation D6943; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice establishes procedures for the evaluation of the resistance of industrial protective coatings to immersion in chemicals.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parenthesis are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

**C868** Test Method for Chemical Resistance of Protective Linings

**D16** Terminology for Paint, Related Coatings, Materials, and Applications

**D610** Practice for Evaluating Degree of Rusting on Painted Steel Surfaces

**D714** Test Method for Evaluating Degree of Blistering of Paints

**D1186** Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base<sup>3</sup>

**D1400** Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base<sup>3</sup>

**D2200** Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces

**D3359** Test Methods for Measuring Adhesion by Tape Test

**D3363** Test Method for Film Hardness by Pencil Test

**D4138** Practices for Measurement of Dry Film Thickness of

Protective Coating Systems by Destructive, Cross-Sectioning Means

**D4417** Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

**D4541** Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

**D5162** Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

**D6132** Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage

**D6577** Guide for Testing Industrial Protective Coatings

**D6677** Test Method for Evaluating Adhesion by Knife

**G113** Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

**ASTM Manual MNL8** ASTM Manual on Maintenance Coatings for Nuclear Power Plants

#### 2.2 NACE Standard:<sup>4</sup>

**TM 0174-2002** Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials on Metallic Substrates in Immersion Service

#### 2.3 SSPC/NACE Joint Standards:<sup>5</sup>

**SSPC-SP5/NACE 1** White Metal Blast Cleaning

**SSPC-SP10/NACE 2** Near White Blast Cleaning

**SSPC-SP13/NACE 6** Surface Preparation of Concrete

### 3. Terminology

3.1 The definitions given in Terminologies **G113** and **D16** are applicable to this practice.

### 4. Significance and Use

4.1 Protective coatings are used on metallic and concrete storage and processing vessels, shipping containers, dams and rail cars to protect the substrate from corrosive attack and to protect stored materials (cargo) from contamination. This method provides a means to assess the ability of a protective coating to resist degradation by chemicals and to protect the liquid cargo from contamination by either the substrate or coating, based on visual observations. Other measures of degradation, such as changes in weight or dimensions of the

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Withdrawn. The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from NACE International (NACE), 1440 South Creek Dr., Houston, TX 77084-4906, <http://www.nace.org>.

<sup>5</sup> Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, <http://www.sspc.org>.

coating material, or chemical changes to the cargo, may be used to assess this protective ability as mutually agreed upon between contracting parties.

4.2 This standard practice covers three approaches to conducting evaluations of a lining coating materials fitness for purpose.

4.2.1 *Method A*—Evaluation of specimens under conditions of constant temperature at atmospheric pressure, (that is, without a thermal gradient).

4.2.2 *Method B*—Evaluation of specimens under conditions which provide a temperature gradient across the sample: The temperature may increase from coated side to uncoated side (Method B1) or decrease from coated side to uncoated side (Method B2).

4.2.3 *Method C*—Evaluation of specimens under conditions of constant temperature and increased pressure, (that is, without a thermal gradient).

4.3 Exposure of materials of known performance (a control) at the same time as the test material is recommended.

## 5. Preparation of Test Specimens

### 5.1 *Metallic Panels:*

5.1.1 Use carbon steel panels with a minimum test size of 51 by 102 mm (2 by 4 in.), minimum thickness 6.4 mm ( $\frac{1}{8}$  in.), unless otherwise agreed upon by purchaser and supplier.

NOTE 1—Test plates with a minimum width of 25 mm (1 in.) may be used if the film thickness is sufficiently uniform to prevent edge effects.

5.1.2 Use nominal 4.8 mm ( $\frac{3}{16}$  in.) thick carbon steel panels in coating tests if a temperature gradient is included in the immersion test, unless otherwise agreed upon by purchaser and supplier.

5.1.3 The minimum surface preparation is abrasive blast cleaning to Near-White Metal condition as defined by ASTM **D2200** and by **SSPC-SP10/NACE 2**. The abrasive and feed pressure shall be selected to produce an anchor pattern, which is compatible with the coating system and acceptable to the coating manufacturer.

5.1.4 Unless otherwise specified or agreed upon by purchaser and seller, surface preparation shall be “White Metal Blast Cleaning” according to **SSPC-SP5/NACE 1**, with surface profile of 38 to 60 micrometers (1.5 to 3.5 mils) as determined by Method C of Test Methods **D4417**.

5.1.5 Other metallic substrates, panel dimensions, or surface preparation are acceptable if agreeable to concerned parties.

### 5.2 *Concrete and Cementitious Panels:*

5.2.1 *Cementitious Panels*—The minimum panel size is 51 by 102 by 25 mm (2 by 4 by 1 in.). Prepare cementitious panels by abrasive blast cleaning in accordance with **SSPC-SP13/NACE 6** or by other method agreed upon between purchaser and supplier.

5.2.2 *Concrete Blocks*—Form, condition and prepare concrete blocks in accordance with the protocol described in Chapter 6 of the **ASTM Manual MNL8**. Prepare concrete blocks by abrasive blast cleaning in accordance with **SSPC-SP13/NACE 6** or by other method agreed upon between purchaser and supplier.

### 5.3 *Coating Application:*

5.3.1 For panels to be fully immersed, apply the coating system to all test panel surfaces that will be subjected to exposure.

5.3.2 Apply the coating system according to the manufacturer’s instructions appropriate for actual or anticipated service conditions. Edges should be protected unless the intent of the experiment is to evaluate the performance of the coating on edges. For coatings to be tested under Method A (immersion with no temperature gradient) or Method C (immersion at high pressure), apply the candidate coating to the back of the panel in addition to the front and the edges to prevent effects from dissimilar coatings.

5.3.3 Dry film thickness of the coating shall be agreed upon between purchaser and seller.

5.3.3.1 Measure dry film thickness of coating applied to ferrous surface in accordance with Test Methods **D1186**.

5.3.3.2 Measure dry film thickness of coating applied to non-ferrous metallic surfaces in accordance with Test Methods **D1400** or **D6132**.

5.3.3.3 Measure dry film thickness of linings applied to concrete or cementitious surfaces in accordance with Test Method **D6132**. Alternatively, measure dry film thickness of linings applied to concrete or cementitious surfaces by using sacrificial surfaces prepared concurrently with test specimens in accordance with Test Methods **D4138**.

5.3.4 Examine the coated surface for holidays in accordance with Practice **D5162**. For test plates and concrete blocks, no holidays are acceptable unless agreed upon between purchaser and seller.

## 6. Sampling

6.1 Test chemicals are to be representative of test materials expected in actual service.

6.2 Prepare at least two test panels or blocks per coating system for each test material.

6.3 Prepare at least one test panel or block per coating system to be used as a file specimen (control specimen).

6.4 Retain an unused portion of each test medium as a blank.

## 7. Test Methods

NOTE 2—This standard describes three methods for immersion testing of protective coatings and linings. Section 8 provides recommended examination methods and intervals between evaluations for the methods described below.

### 7.1 *Method A—Immersion with No Temperature Gradient:*

#### 7.1.1 *Test Apparatus:*

7.1.1.1 A closed vessel constructed of glass or other inert material is used with capacity to hold one or more test specimens with means to relieve pressure if operated at elevated temperatures.

NOTE 3—Slowly evaporating media may not require a closed vessel.

7.1.1.2 Specimens should be positioned so as to avoid specimen to specimen contact.

7.1.1.3 For immersion at high or low temperature, insulation of the vessel is recommended. A separate test vessel is recommended for each type of coating system being evaluated.